The Future of the Circular Economy & the Circular Economy of the Future

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Purpose
The Circular Economy (CE) has gained momentum in recent years as a new economic paradigm. While the CE sets a very defined vision for a sustainable future it still operates in the present. As such, existing guidance on and research into the CE lacks a necessary understanding of how to go from the present to the future. What if the future is different from what the CE expects? The CE cannot answer this question adequately and therefore is not capable of developing this understanding alone. To address this shortcoming, this paper proposes Futures Studies (FS) as a complementary discipline because it offers exactly what CE lacks: methods to explore alternative futures.

Design/methodology/approach
To understand the level of interdisciplinary research in the built environment between CE and FS, a systematic literature review is carried out using a bibliometric review and a snowballing technique. This manuscript reviews seminal literature in both fields and their theoretical background.

Findings
This paper demonstrates the lack of collaboration between CE and FS and highlights a systemic failure within CE, which is to consider the future as unknowable. It further provides an initial understanding of where the synergy sits, recommendations on where to start and introduces some of the FS chief methods that could be used by CE in the built environment.

Originality
This research represents a first step towards embedding realistic considerations of futures into the CE debate. To our knowledge, this research is the first of its kind by considering FS into the CE debate.

Keywords: Circular Economy, Futures Studies, Foresight

1. Introduction

There is a pressing need to transition to a more sustainable future (Geissdoerfer et al., 2017). Circular Economy (CE), as a new economic and development paradigm, has gained significant traction in the last years (Kirchherr et al., 2017). However, some believe that this concept still needs to be critically questioned (Lazarevic and Valve, 2017; Hobson and Lynch, 2016; Gregson et al., 2015) to demonstrate its ambition to be the most suitable paradigm to accelerate the transition to sustainable development (Pomponi and Moncaster, 2017). While the CE operates in the 'here and now' it also sets a clear vision for a sustainable future. Still, existing guidance on and research into CE lacks a necessary understanding of how to go from the present to the future. What if the future is different from what CE experts presuppose? The CE community alone cannot adequately answer this question, and this is the operating space of Futures Studies (FS). It is, therefore, surprising that the two communities—whilst working towards the same goal of a sustainable tomorrow—show little to no interaction.

Against this background, this paper has two objectives. Firstly, it provides evidence of the existing lack of collaboration between CE and FS communities in the built environment, using a bibliometric review and snowballing technique. Secondly, it offers an initial approach that integrates CE principles and FS methods as a preliminary model for CE to address the future thoroughly. We argue that FS could complement CE, where visions created in synergy are put into action systematically and then pursued to be sustained.

The remainder of the paper is structured as follows. In Section 2 we summarise and discuss how the concept of CE has evolved, building on the fundamental contributions of eight schools of thought, followed by an analysis of the current debate in this field of study. In Section 3 we introduce the FS discipline, explain its suitability for contributing to CE's future approach and introduce four of its chief methods. Section 4 elaborates on a synopsis that demonstrates the lack of interaction between these communities and analyses the few publications where the two fields interact. Section 5 discusses where the synergy between CE and FS sits and gives recommendations on how this untapped potential could be accessed. Section 6 concludes the paper.

2. Circular Economy: defining contributions

This section outlines the authors, concepts and schools of thought (SoT) from which the concept of Circular Economy has evolved since the late 1960s.

The earliest author that had a major influence on the CE was Boulding (1966) with the seminal essay '*The economics of the coming spaceship Earth'*. The relevance of this author is twofold. Primarily, because Boulding wrote over 53 years ago about the two types and contrasting modes (i.e. linear and circular) of extraction, production and consumption that are debated today. What Boulding (1966) called

'cowboy economy' is now called 'linear economy'; a "reckless, exploitative and violent behaviour towards the environment" (p. 7), to which he proposed the 'spaceman economy' (now called 'circular economy') as a solution, where man "must find his place in a cyclical ecological system" (p. 8). The second reason for the relevance of Boulding's work, and that none of the other SoT considered, is the importance this author sets on the concept of the *future*. Boulding (1966) argued that there was a great deal of historical evidence to suggest that a society which loses its connection with the past and its positive image of the *future* also loses its capacity to deal with the problems in the present, and soon falls apart.

Stahel (1982) also influenced CE. This author discussed the extension of the use-life of goods to transition towards a sustainable society and proposed a 'performance economy' based on a spiral-loops system that "minimises matter, energy-flow and environmental deterioration without restricting economic growth or social and technological progress" (p. 74). Stahel (1982) also proposed product-life extension activities (e.g. reuse, repair, reconditioning, upcycle, restore, etc.) that are now part of CE's core activities at CE micro-level, i.e. for materials, components and products.

The third influence on CE is the concept of 'industrial ecology' by Frosh and Gallopulos (1989). These authors contributed with a strong argument on how the traditional industrial model back in 1989, which has failed to change substantially till this day is mainly preoccupied on maximising the immediate benefits for producers and consumers rather than the economy as a whole. Frosh and Gallopulos (1989) proposed an 'industrial ecology' for a holistic approach that seeks a sustainable balance between economic benefits and environmental needs. A novel concept introduced by these authors was the idea of 'waste equals food', where residues from one industrial process can serve as raw materials for another, thereby reducing the industry's impact on the environment.

The fourth influence, 'regenerative design', coined by Lyle (1996) is described as a means of "replacing the present linear system of throughput flows with cyclical flows at sources, consumption centres and sinks" (p.10). Lyle also described this proposed regenerative system as one that "provides continuous replacement, through its own functional processes, of the energy and materials used in its operation" (p.10). This author proposed to use energy from renewable sources and minimise the use of fossil fuels, to maximise the utilisation of materials by reusing them and to keep waste volumes within the environment capacity to re-assimilate them without irreversible damages.

The notion of a CE also has its roots in 'biomimicry' (Benyus, 1997). This concept goes beyond the previous ones in the value it places on nature, by making a case for the major importance of learning from it in order to solve human, business and technological challenges. It relies on three key principles: nature as a model to solve human problems; nature as a measure to judge human innovations; and nature as a mentor (Webster, 2017). Biomimicry argues that, after 3.8 billion years of existence, humans are

not in full control and nature knows better than us what works or not, what has longevity on Earth and how it should be designed. The core metaphors that CE uses are essentially, like biomimicry, taken from the ecological system; this is a major plank of interest in, and also resistance to, CE.

'Natural capitalism' by Lovins, Lovins and Hawken (1999) also influenced CE but in a practical sense rather than a philosophical one. These authors criticise the effects that pure capitalism has on nature and propose instead a paradigm shift where "the economy is a wholly-owned subsidiary of the environment, not the other way around" (p. 1). They proposed a new set of four principles: to use resources more productively through new design practices (1); to redesign production on biological lines with a closed loop approach, i.e. no waste and no toxicity (2); a shift of business models from selling goods to leasing a continuous flow of services according to customers' evolving needs (3); and to reinvest business profits into restoring, sustaining, and expanding natural capital (4). The concept of natural capitalism is also relevant because it proposes a shift from taxation on jobs and income to taxation for depletion and pollution, and that revenue from this is later used to repair damages to nature.

The penultimate big influence on CE is 'Cradle-to-cradle', a concept developed by Braungart, McDonough and Bollinger (2007). This work laid out how products should be designed by differentiating between two types of metabolism in an industrial process, biological and technical, to keep the value in materials and components as high as possible for the next use cycle. This would cause a shift from efficiency to effectiveness, aiming to have a good effect instead of a 'less bad' effect on the ecological system. To be effective CE, like all living systems, must be "dynamic but adaptive, neither courting disaster by over-extending efficiency (brittleness) nor becoming too resistant to change (stagnation)" (Webster 2017, p. 21).

The latest major influence on CE so far is the concept of 'blue economy' from Pauli (2010). This proposes an open-source movement and an innovative business model which uses local communities to bring competitive products and services to different markets, thereby fulfilling the communities' basic needs while building social capital and living in harmony with nature. If biomimicry puts nature at the centre of everything, blue economy promotes a balance between nature and human kind. This SoT, perhaps more than all of the other major influences, questions the current economic model in a more radical way. Its approach is eudaemonic and is preoccupied not with scale but with adding value to well-being with what is available. It favours local economies, cultures and traditions and uses the available resources in cascading systems, where the waste of one product becomes the input to create a new product with its new cash flow.

2.1. CE: an umbrella concept

Given CE's transversal and multidisciplinary nature (Ruiz-Real et al., 2018), until now there has been no single definition of, or consensus about, what CE means (Kirchherr et al., 2017). This comes as no surprise because CE is an umbrella concept that is based on a core 'metabolist', 'living systems', 'effective systems' metaphor group (Webster, 2017) which evolves from the eight SoT explained and summarised in the previous section.

For the sake of clarity, when referring to CE we align ourselves with the definition proposed by the Ellen MacArthur Foundation (Webster, 2017): "A circular economy is one that is restorative by design, and which aims to keep products, components and materials at their highest utility and value, at all times" (p. 17). Within the context of the built environment, which is defined here as "the physical world that has been intentionally created through science and technology for the benefit of mankind, ranging from the large-scale civic surroundings to personal places" (Hollnagel, 2014, p. 222) CE is about the effective management of resources and offers significant opportunities to optimise energy use, reduce greenhouse gas emissions and waste generation (Pomponi and Moncaster, 2017), and increase renewable energy use and the use of bio-based non-toxic materials, among others.

With the purpose of explaining how the main characteristics, principles and aspirations of CE connect to the SoT we have outlined the key relationships in Figure 1.

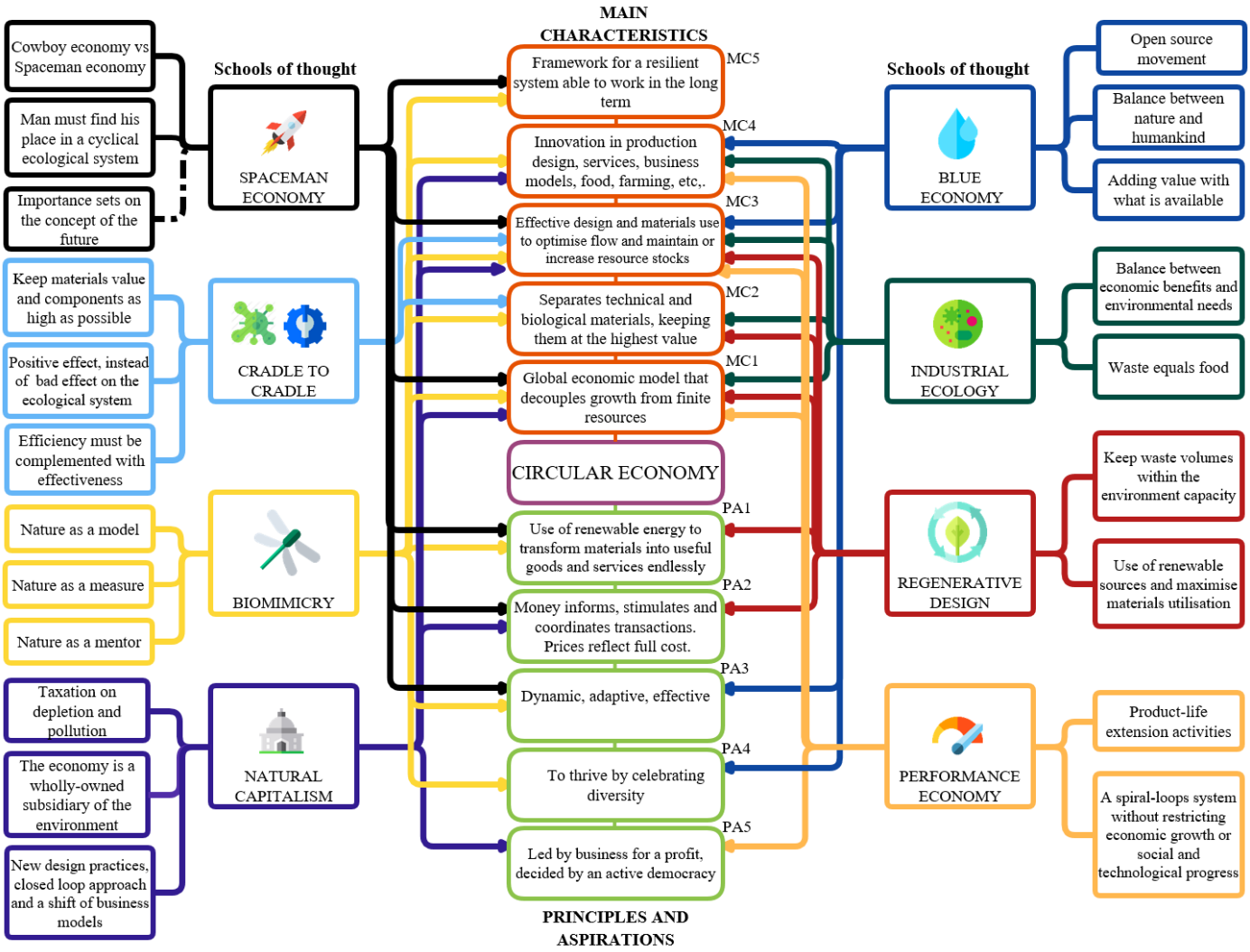

Figure 1. CE dynamics (source: authors)

The most relevant contributions of the SoT to CE can be identified when the boxes at the far left-side and far right-side of the diagram in Figure 1, and their connection with the corresponding boxes of the SoT, are followed. Successively, a group of 37 arrows connect the SoT boxes with the CE's main characteristics. Some of the most relevant dynamics observed on the diagram are discussed below.

One of the most noteworthy main characteristic (MC) is the third one (MC3); *effective design and the use of materials to optimise their flow and to maintain or increase the technical and the natural resource stocks*. This is the only main characteristic, out of five, to which all eight SoT contribute. This CE characteristic exists because all of these SoT have the same view of the current economic model: the dominant industrial economic system is not sustainable and a new and positive interaction with the environment needs to be established.

In contrast, just two of the SoT contribute to MC5: *CE establishes a framework and building blocks for a resilient system able to work in the longer term*. Spaceman economy is the main contributor to this characteristic because, as was highlighted in section 2, it is the only SoT that stresses the relevance of the concept of the future. To spaceman economy the current economy is built around a weak understanding of how the physical world operates and the potential consequences of global production and consumption. Therefore, focusing on the future and the anticipation of possible future challenges, rather than adaption to them, ought to be translated into an actionable systemic framework for an urgent transition from the linear to the circular economy.

Biomimicry is the only other SoT that also contributes to MC5 (however, from a perspective inspired by nature). In contrast to spaceman economy, biomimicry uses the concept of adaption through resilience, rather than through anticipation, to cope with and to be ready to face the challenges that an uncertain future may bring. Biomimicry contributes to CE suggesting that any innovation in the built environment should use nature as a mentor, model and measure to address the challenges facing humanity.

In the case of MC1; *CE is a global economic model that progressively decouples economic growth and development from the consumption of finite resources*, a vastly more heterogeneous and diversified set of contributions to CE originates from the SoT. Seven SoT contribute to this characteristic, the second highest after MC3, however, they prioritise the global economy, the environment and humankind differently. We categorised these seven SoT contributions accordingly and divided them in two groups. The first group includes four SoT; spaceman economy, cradle to cradle, biomimicry and natural capitalism which prioritise the environment over humankind and humankind over the global economy. A second group includes industrial ecology, performance economy and regenerative design. They do not prioritise any of the dimensions but suggest a balance between the three. Blue economy is excluded as it does not prioritise its contribution for a global economic model but rather to strengthen the local economy of communities with what is available. Blue economy is sceptical about ecological modernism (a strong emphasis on the roles of technology and economic growth in adequately addressing the world's social, economic, and environmental challenges) (Caradonna et al., 2015), opposite to the others SoT.

Moving on to the CE principles and aspirations (PA), at the bottom of the diagram, the dynamics and contributions from the SoT are not as numerous or as combined with the main characteristics. Based on the number of connections from the SoT to this section of the diagram, they contribute less than 40% of the total contributions. There is one school of thought, industrial ecology, which despite contributing significantly to CE's main characteristics, especially through the concept of industrial metabolism, does not contribute to any of the principles and aspirations.

Another significant trend shown in this section of Figure 1 is that the only SoT that contributed to MC5, spaceman economy and biomimicry, are also the only two that contribute the most (three out of five) to the CE principles and aspirations.

On the one hand, spaceman economy connects to the use of renewable energy (PA1) and the role of money (PA2), and it proposes an economy that is effective in order to endure. On the other hand biomimicry also connects to PA1 and PA3, but this SoT does not have a position about the role of money (PA2). However, it does connect to thriving by celebrating diversity (PA4), a clear element found in nature, therefore CE is aligned and embraces this principle and aspiration.

2.2. Circular Economy: current debate

CE has been confronted with the following arguments from academia during the last years. Geissdoerfer (2017) and D'Amato et al. (2017) have argued CE is still very limited and that there is considerable room for conceptual improvements and for being more receptive to other research fields. Most of the academic and practitioner literature appears to be too optimistic and approbatory (Gregson et al., 2015; Leising et al., 2018). Recent studies argue that CE must be subjected to more in-depth examination (e.g. Lazarevic and Valve, 2017; Petit-Boix and Leipold, 2018). A consequence of these limitations within CE is that even conflicting conclusions have been found in recent publications, particularly regarding the concept of decoupling growth (e.g. Temesgen et al., 2019; Kjaer et al., 2018; Mayer et al., 2018; Ward et al., 2016). For example, while CE as an economic system promises to decouple economic growth from environmental impacts and resource extraction, Ward et al. (2016) showed there are no evidences yet showing that this could be achieved in absolute terms.

The EMF predicts that by 2030 a full adoption of CE in Europe could produce better welfare, environmental and social outcomes that the current economic model. Interestingly, it was found by Lazarevic and Valve (2017) that this forecast is highly optimistic because it presupposes that innovation will have a higher pace than what has been observed in the past. Moreover, higher rates of innovation do not necessarily result in increased welfare. Similar optimistic assumptions also seem to form the basis of other studies by the World Business Council for Sustainable Development (e.g. Thelen et al., 2017), leading design studios specialised in CE (e.g. Douma et al., 2017) and journal publications such as Kuzmina et al. (2019) and Mont et al. (2014). Suggestions from these publications are highly approbatory of CE and the very few publications that have explained how they modelled the future (e.g. Neuvonen et al., 2014; Sinclair et al., 2018) ended up building overly optimistic versions, quite disconnected from realistic economic models. Therefore, evidence seems to point towards a CE community being fixated on the future but certainly not proactively engaged in learning how to study it and reluctant to embrace the possibilities of alternative futures (Dufva et al., 2016).

CE also needs to be monitored from a systems perspective to avoid incoherent CE actions taking place that do not contribute to sustainable development (Pauliuk, 2018). This is particularly relevant for cities and the wider built environment. This lack of a tailored, systemic and detailed focus from the CE on the built environment has been highlighted by Pomponi and Moncaster (2018) in their review and critique of the BS8001, the world's first standard on CE. As a consequence of these limitations, it has become common practice among CE practitioners' publications to encourage decision makers to learn by doing, to ask them to experiment in order to know how CE really works and at the same time encourage them to lead in the transition to CE (e.g. Thelen et al., 2017; Douma et al., 2017).

Webster (2013) made evident the absence of a developed approach to the future from the CE discipline: "A linear economy has no real future. But, a circular economy is assumed to be a long-term proposition; it makes a positive assumption about the future: well, simply that there will be one!" (p. 547). Webster's work (2013) came as a seminal milestone to avoid wasting time and effort in developing a theoretical framework for the CE from scratch, for he provided a compelling argument for using all the things already known and acknowledged the vast theoretical basis, primarily on systems thinking, that is available to progress the CE. Yet, he also recognised the major lack of an operational tool to study the future (Webster, 2013).

Bearing in mind these CE limitations, we aim to contribute to the ongoing debate, initiated by Pomponi and Moncaster (2017), who emphasised CE must take a future-oriented and multidisciplinary approach, by questioning CE from a complementary angle. So far CE lacks an operational tool to systematically explore the possible, probable and preferable futures in the built environment. We consider this to be relevant because CE suggests significant changes on the macro-scale, and articulates a radical shift for people and the planet (Lazarevic and Valve, 2017).

Considering that CE tries to improve and advance the existing economic model, it should not make the same mistake of neglecting to develop a foresight capacity as the linear model did. This opens the possibility to look for other fields of study that have the theoretical framework and have developed suitable methodologies that CE could use to elaborate on and integrate the study of the future.

3. Futures Studies

The consequences of the industrial period have progressively limited the planet's capacity to support humankind. Climate change is now the world's biggest concern for policy-makers according to a recent global survey (Rosane, 2019). World problems such as freshwater shortages, global warming, ocean depletion and pollution, land degradation and loss of biodiversity are moving ahead at a speed faster than the ability of humanity to solve them (Rockström et al., 2014; 2016; Stuchtey et al., 2016). They are growing in complexity without really being challenged with transformative alternatives for the

future. As Tonkinwise (2014) argues, “the futures we are getting hardly seem like the ones we explicitly decide on; they are more like the messed-up ones we are drifting unwittingly and implacably into” (p. 170).

From an economic perspective these futures revolve around explainable, notwithstanding self-destructive decisions, in terms of the creation and deployment of money as credit, subsidising fossil fuels, the failure to distinguish economic rents from productive economy and the allied failure of tax systems to tax what is ‘bad’ instead of what is ‘good’. We recognise that capitalism has achieved enormous benefits for human kind (e.g. Stuchtey et al., 2016); however, we agree with Harari (2019) in that images of the future can change over time to affect the future positively. There is enough evidence to show that the effects of capitalism on society have concentrated the benefits over a few, but the costs are borne by everyone (e.g. Stuchtey et al., 2019). To sum up, the current approach towards the future has proven to be incapable of transitioning to a more sustainable economic system and, as a consequence, is ineffective in its responses to global challenges.

FS is an evolving discipline equipped with suitable tools to navigate the turbulent conditions ahead (Slaughter, 1998). In general terms FS is understood as “the systematic study of possible, probable and preferable futures including the worldviews and myths that underlie each future” (Inayatullah, 2013, p. 37). In the context of the built environment, FS can be seen as a systematic way to develop a range of contrasting views and possible paths that describe how the future might unfold or how we would or would not like it to develop. The concept of FS within the built environment should incorporate the understanding of these paths sufficiently well to enable the proposition of which decisions and actions should be made in the short, medium and long-term to create the best possible future (Horton, 1999).

In principle, FS believes that human actions have agency to construct preferable futures rather than being passive responders (Derbyshire et al., 2016). The purpose of FS is to maintain or improve the welfare and freedom of humans, as well as the welfare of all living beings, plants and the earth’s biosphere for their own sake (Bell, 2009). The high value of FS, as Medina (1999) suggests, is in its willingness to transform the present for a better future. By creating a diverse set of future images, we could be better prepared for how the future may actually unfold (Dufva and Ahlqvist, 2015).

FS includes qualitative and quantitative means of monitoring clues and indicators of evolving trends and developments, and is best and most useful when it is directly linked to policy implications (Uotila et al., 2012). FS usually challenges the orthodox future and approaches longer horizons than planning. From ten to fifty, and even to a hundred years (Inayatullah, 2008; Meissner, 2012). FS has grown recently as it has proven its capacity of coping with, and deepening our understanding of uncertainty (Ladu and Quitzow, 2017; Nováky et al., 2017; Vecchiato, 2012), its renewed methodologies to

understand unstable situations, and the tools implemented to bring community and scientists together towards accepted future alternatives (Meissner, 2012; Nováky, 2010).

We agree with Medina (1999) and Uotila et al. (2012) when they argue that the main challenges facing FS are becoming more effective at sharing the images of an interpreted future with a wider community and strengthening dialogue with other disciplines. This is extremely relevant because when these images of created futures are shared effectively they could be transformed into a vision and put into action in a systematic and sustained way (Medina, 1999). This is where we believe that a synergy with CE also contributes to FS, by testing, implementing and demonstrating the functionality of FS methods for CE. As Uotila et al. (2012) also argue, explicit FS outcomes can result in knowledge which is more difficult to absorb, but if absorption of this knowledge succeeds, it supports new learning, novel insights on the futures, and could also contribute to radical positive innovations in the built environment.

3.1 Futures Studies methods

FS is equipped with more than 40 methods and they are classified into four categories: qualitative or quantitative, and normative or exploratory (Glenn, 2001). The field of FS describes the different methods in the manual of the Millennium Project (Glenn, 2001), and for the purpose of this research the following four chief methods were reviewed.

The Futures Wheel (Glenn, 2001) method resembles a three-ringed wheel, hence its name. The most important trend or event is written in the centre of the wheel, small spokes are then drawn wheel-like from the centre and filled in with the primary consequences or impacts caused by the main event or trend. This ripple effect must continue until a clear picture of the implications of the event are unfolded.

The method of Causal Layered Analysis (CLA) according to Dator (2003) "is a very sophisticated way to categorise different views of and concerns about the futures, and then use them to help groups think about the futures far more effectively than they could by using any of the layers alone, as most theories and methods do" (p. 1). This method considers three overlapping research dimensions: empirical, interpretative, and critical. Subsequently a fourth perspective emerges which is 'action research'. All of these dimensions have different assumptions about the role of the subject being analysed and about the nature of the future. What makes this method unique, as Glenn (2001) reminds us, is that "hidden meanings and ideologies, structure and consciousness, and myth and metaphor are not seen as outside of foresight but as part of the enrichment process" (p. 5).

Delphi is a further FS method, whose purpose is to reach consensus within a core understanding of systems thinking. The main strength of Delphi is its ability to explore issues that require judgment from several disciplines objectively. As a result, this method is recognised as the best method within FS to collect and synthetise multiple positions on a subject.

A special place within FS is reserved for the Scenarios method because scenarios are also the end product of futures research, as a way of summarising the results of each and every method used by a futurist (Bell, 2009). Four examples of scenarios are inductive, deductive, incremental and normative (Wilkinson and Eidinow, 2003) and each could be implemented according to the challenge and the desired purpose. Furthermore, scenarios serve three purposes according to Bezold (2009). The first is to bound the range of uncertainty and display the broad range of possibilities ahead. The second is to stimulate the exploration of both dangers to be avoided and positive possibilities that can be used in constructing a vision of the preferred future. The third is to test how potential strategies and actions might work in different future circumstances, to assess how 'robust' strategies are across multiple scenarios.

4. Methodology, results and proposed approach

To understand the level of interdisciplinary research in the built environment between CE and FS, a systematic literature review was carried out. The first approach used to gather information was a bibliometric review. Data was sourced from Dimensions, an inter-linked research information system provided by Digital Science (Dimensions, 2019). We used this software due to its dynamic research data platform to explore connections and develop meaningful data. However, to corroborate our findings we also searched two additional academic search engines; Google Scholar (Google Scholar, 2019) and Microsoft Academic (Microsoft Academic, 2019). The keywords used were 'circular economy', 'futures studies' (and/or 'foresight') and 'built environment'. Data collected for this study was last updated in September 2019. When these keywords were used to search for titles and abstracts we found only one relevant paper out of four overall results. Seidel et al. (2017) discussed FS and recommended the use of these methods particularly for a transition from traditional business models to sustainable ones, and specifically when applied to the manufacturing field.

A snowballing technique (Jalali and Wohin, 2012) was adopted as a further step in our bibliometric analysis for a more in-depth assessment. 285 publications including books, journals and consultancy publications were analysed using this approach (a supplementary document is included to provide the readers with a list of the most recommended books and journals reviewed). The snowballing procedure was stopped when no new publications relevant for this research were found. Our procedure started by first identifying the publications that described, discussed and/or implemented CE or FS in the built environment while concurrently checking if these publications mentioned the other field of study (CE mentioning FS or vice versa). To do this, a scan of titles and abstracts was conducted followed by an examination of the full content of the relevant publications. Our findings revealed that just one very

recent publication exists, De Jesus et al. (2019) which discusses CE implementation in the built environment using FS methods.

The central focus of this study by De Jesus et al. (2019) is similar to our research as the scope is also within the built environment and the authors argue that, as a field of study, CE lacks a structural process to transition from a linear to a circular economy. As a solution, they propose to use FS methods alongside CE, especially "for envisioning the end state (bringing the CE into sharper focus) and the 'pathways' of transition in helping decision-makers and business actors to explore and prepare their future CE efforts" (p. 1495). This paper also stresses the fact that both fields of study seldom talk to each other and they try to fill this gap by deploying the Delphi method. However, in their implementation of the Delphi, De Jesus et al. (2019) only invited CE experts and practitioners to participate. The authors believe the analysis and conclusions reached by De Jesus et al. (2019) could have been richer had they included experts from other fields in the panel. Their study also did not combine at least two FS methods or translated findings into possible scenarios which is what FS experts usually recommend (Glenn, 2001).

Although De Jesus et al.'s (2019) work is the only one where CE, FS and the built environment intersected, it is worth noting that a handful of the publications referring to CE have started to use FS methods especially at the micro-level (e.g. Kuzmina et al., 2019; Sinclair et al., 2018; Seidel et al., 2017).

Kuzmina et al. (2019) envisioned the future of the Fast Moving Consumer Goods (FMCG) industry within a CE context. While these authors have contributed to the field of CE by constructing futures scenarios and illustrating the benefits of FS, they did not describe what the process was or the FS method used to arrive at those scenarios. It is also worth emphasising that the scenarios that were created did not consider the contrasting possibilities of where the FMCG industry could be heading. For example, the five scenarios 'rinse and reuse', 'cycling of pure materials', 'the rise of the circular retailer', 'a world without supermarkets', and 'connected living' are just aspirational snapshots of what a circular future may hold. However, less positive or even dystopian scenarios could also have been used to alert decision makers or as a call to action on what needs to be done in order to avoid those outcomes. As Gabriel (2013) mentions, when implementing a FS method, participants may explore alternatives that none of the experts actually believe will happen, but could be plausible under certain reasonable conditions. This is a specific example to show how CE research can benefit from FS methods.

Neuvonen et al. (2014) and Mont et al. (2014) created broader scenarios, focusing on understanding what a low-carbon future and more sustainable lifestyles would look like for societies living in 2050. For example, Neuvonen et al. (2014) developed four low-carbon scenarios and forecasted that a considerable increase in fossil fuel prices would persuade people to transition to renewable energies without a substantial conflict. However, recent events in France have proven this assumption to be

inaccurate as a 20% increase in the price of diesel has caused a significant and violent social mobilisation to fight against this policy since it was implemented last year. This incident is a manifestation of a wider problem we mentioned in section 2, i.e. the negative effects of capitalism, combined with a lack of political courage to tax corporations (those who produce diesel) instead of the less privileged (those who drive the diesel trucks in France) and who ended up paying the costs. By thinking in CE terms, the government could have used the diesel revenue collected to aid those on whom this fuel tax fell the hardest.

Dufva et al. (2016) proposed integrating FS into the everyday activities of organisations, rather than as a separate process when it is already too late to react to the perceived challenges. These authors focused on the role of 'gaming' within FS and proposed 'foresight games' to be used by CE practitioners to generate new insights about alternative futures. We agree with their conclusions about what should be the right motivation for CE to use FS: "the focus is not on how open or closed the futures are, but rather what can be learned from them. The learning process is not about learning to predict the future, but about orienting towards the future. This means being open to alternative futures, sensing weak signals of change and proactively working towards a preferred future" (p. 569).

4.1 An interdisciplinary approach

One of the CE's system primary characteristics of considering the future as unknowable was discussed in Section 2.2. This is a manifestation of CE's adaptive nature (a key contribution it received from biomimicry); CE adjusts itself according to the conditions it is being challenged with. By contrast, the FS system considers the possible futures to be known. This is a manifestation of FS being anticipatory; by using the information explored and gathered by its methods FS has the capacity to adjust present behaviour based on foreseen future threats or opportunities. These two contrasting, and we also think complementary, principles (adaption and anticipation) suggest a strong potential for collaboration between both fields of study, at least theoretically. How do we believe this collaboration could be made possible in practice?

We propose a preliminary approach as illustrated in Figure 2. On the left-hand side of Figure 2 we have included the Generic Foresight Process Framework (GFPF) from Voros (2003). We believe that this FS framework could contribute to develop CE's long-term strategic foresight capacity and benefit from the study of the alternative potential futures. This is illustrated by the GFPF's six key elements: inputs, analysis, interpretation, prospection, outputs and strategy. This generic framework also includes some of the FS methods in its corresponding recommended stage (Delphi for Inputs, CLA for Interpretation, Scenarios for Prospection, and so forth). On the right-hand side we have included the "Butterfly" diagram from the Ellen MacArthur Foundation (2013) as a representation of CE.

We have placed both, the GFPF and the "Butterfly" diagram, next to each other to symbolise interdependence. In sum, we conceptualise the GFPF as being a continuous activity that informs strategic thinking and is the basis for actions to be taken anticipatorily in the present by CE. We believe that, with this combined methodology, FS will enable CE to have a more mature approach towards possible futures and to integrate that knowledge into existing work, research and action towards sustainable futures. Therefore, we propose this framework to be put to test as a starting point by CE practitioners in the built environment. This proposed framework also offers common ground for an interdisciplinary discussion between CE and FS research communities. Even though this framework is only presented here in preliminary terms we believe some thought-provoking points and subsequent applications could be deduced from it.

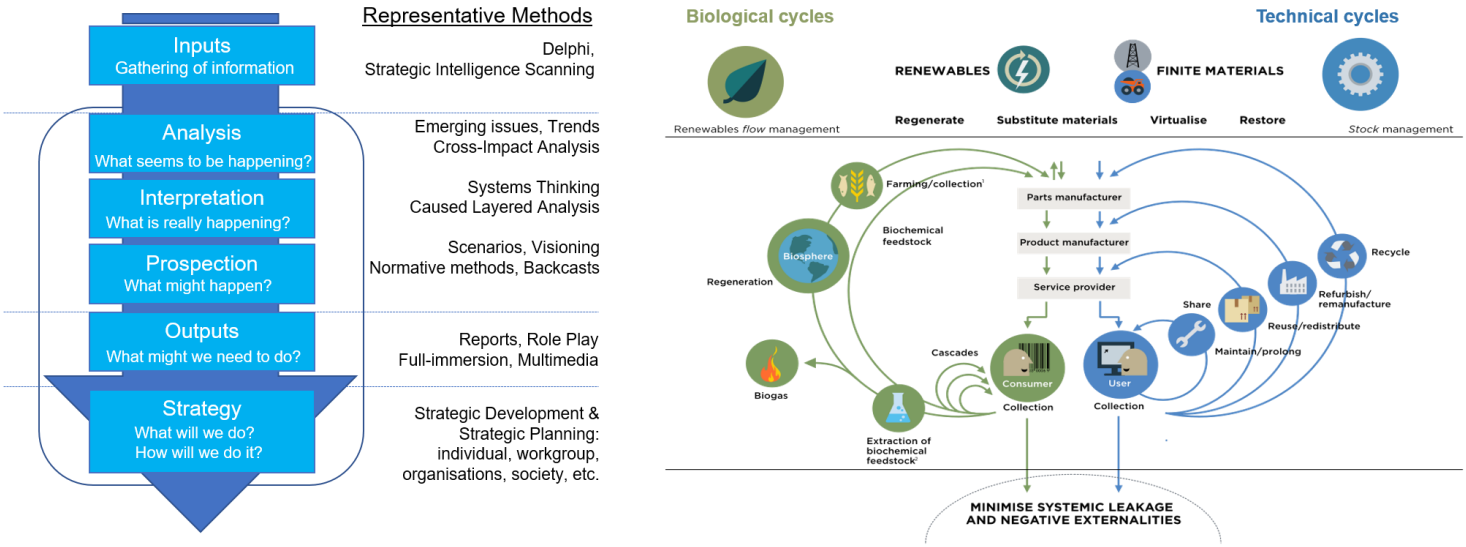

Figure 2. Generic Foresight Process Framework (Voros, 2003) and the "Butterfly" diagram (Ellen MacArthur Foundation, 20013)

5. Discussion

There are major shared characteristics between CE and FS. The most important elements they share are the long-term, big picture, and radical change orientation. This article has identified how the CE has evolved, building on the fundamental contributions of eight schools of thought. However, CE still needs to be more receptive to other research fields (Geissdoerfer, 2017) to allow conceptual improvements to be made (D'Amato et al., 2017). We believe that an interdisciplinary approach that integrates FS

methods in the CE as a system, is the key to the CE being implemented more effectively in the built environment.

CE as a field of study is built on a vision of the future as it might benefit from ecological modernism (economic growth decoupled from resource constraints). This is a technical rather than a political fix based on production decisions. In turn, these decisions are based on increasing efficiency using technology (largely digital these days) to increase productivity; except that as well as labour productivity, it adds resource productivity as a source of added value by adjusting business models and consumers behaviour along with it. CE expects a future shaped by the forces surrounding supply, minimal governance and global and technological imperatives. However, this is just a partial vision and is only one story of how transformation should and will take place (Lazarevic and Valve, 2017).

Therefore, a feasible interface between CE and FS might be under the following assumptions. FS has most to offer CE as an exploration of differing macro models into which the ecological modernism (in which the CE is grounded) can fit or not. CE, as an economic and development paradigm, is a trial for notions of stock maintenance, effective flows in dynamic systems, the interplay of resilience with efficiency and how that might unfold into the design of suitable macro-models. Here, the underlying metaphors around metabolism are being explored through CE lenses. So, how would it all look if the rest of the economy was viewed at a different way?

CE and FS, guided by a shared systems scientific approach and inspired by living systems, could provide a new narrative for positive social change. This is why it is so imperative for humanity that these two communities start to interact as soon as possible and open and maintain productive collaboration to accelerate the transition towards a sustainable economic system.

With respect to the CE and FS research communities we found that these academic communities tend not to publish in the same peer reviewed journals (Weigend et al., 2019). As a consequence, it is likely both fields of study have different reading communities, meaning that although even if the information is available in these publications, some people may not access it as they are not the intended audience. We believe that the mainstream FS journals, such as Journal of Futures Studies and The World Future Review, would be good platforms to disseminate collaborative research and could act as a stimulus for the crossover and cross-fertilisation of research ideas from both communities. This could serve as a springboard for further interdisciplinary studies between CE and FS.

6. Concluding remarks, limitations and further research

In the past years increasing attention has been paid to Circular Economy, however this concept still needs to be critically questioned. This research contributes towards this questioning by highlighting one

of the CE system principles as a global economic model, which is to consider the future as unknowable, and proposes FS as the operational tool for CE to explore the possible, probable and preferable futures.

We have provided an initial understanding of where the synergy sits, recommendations on where to start and have introduced some of the FS chief methods that could be used by CE. Our main purpose has been to challenge the CE research and practitioner community to elaborate and integrate FS in their practice. The FS community could, on their part, evaluate whether existing methods are fully suitable for CE research or if new developments or refinements are required. As a starting point, we have provided an initial approach that integrates CE principles and FS methods.

It is important to consider the limitations of this research, imposed by the methods used. Our bibliometric review and snowballing technique might have missed some literature that falls within the scope. Such limitations could be, on one hand, due to our bibliometric review approach (selecting publications based on matching keywords). On the other hand, the snowballing technique could be affected by our subjective judgments on which of the publications are worth exploring based mainly on the title and abstract of the paper.

Despite these limitations, this paper has highlighted a substantial opportunity for a beneficial collaboration between these two fields of study that we feel would be extremely worthwhile exploring. Further work needs to be done to establish what both fields could offer each other in more detail. A comprehensive review of the methods available within FS and how to integrate them into CE would also be extremely valuable. With the aim of stimulating discussion and further dialogue between these two fields we invite researchers and practitioners from CE and FS to collaborate on addressing the role of FS and its integration within CE.

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